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# **Biomimetic surfaces**

preparation, characterization and application

av

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## Abstract

This thesis describes the preparation, characterization and application of a few biomimetic surfaces. Biomimetics is a modern development of the ancient Greek concept of mimesis, i.e. man-made imitation of nature. The emphasis has been on the preparation and characterization of two types of model systems with properties inspired by nature with future applications in bioanalysis, biosensors and antifreeze materials. One type of model system involves phosphorylated surfaces; the other consists of surfaces mimicking antifreeze (glyco)proteins. The surfaces were made by chemisorbing organosulfur substances to a gold surface into monomolecular layers, so called self-assembled monolayers (SAMs). The physicochemical properties of the SAMs were thoroughly characterized with null ellipsometry, contact angle goniometry, x-ray photoelectron spectroscopy and infrared spectroscopy prior to application.

The work on antifreeze surfaces was inspired by the structural properties of antifreeze (glyco)proteins, which can be found in polar fish. Two model systems were developed and studied with respect to ice nucleation of condensed water layers. One was designed to mimic the active domain of antifreeze glycoproteins (AFGP) and the other mimicked type I antifreeze proteins (AFP I). Subsequent ice nucleation studies showed a significant difference between the AFGP model and a (OH/CH<sub>3</sub>) reference system displaying identical wetting properties, whereas the AFP I model was indistinguishable from the reference system.

The model systems with phosphorylated surfaces were inspired from phosphorylation and biomineralization. Two systems were developed, short- and long-chained amino acid analogues, with and without a phosphate group. A novel approach with protected phosphate groups before attachment to gold were developed for the long-chained analogues. The protective groups could be removed successfully after assembly. The long-chained SAMs were evaluated with electrochemical methods and significantly higher capacitance values were observed for the phosphorylated SAMs compared to the non-phosphorylated.